Q4: What is expected for sufficient ventilation in MRW fixed facilities?

A4: The requirements for sufficient ventilation depend on the specific operation being performed and the equipment and materials involved. The materials which are common to MRW facilities and need ventilation include airborne dust from absorbents during lab packing and toxic and flammable vapors during packing and bulking operations. Compressed gas containers, such as butane and propane bottles, may also need ventilation and other safety measures according to the fire code. There is also a general need to ventilate work areas. Ventilation performance and specific requirements are related primarily to MRW worker health and fire and explosion hazards. Detailed guidance and rules apply from the Department of Labor and Industries (L&I) and the locally adopted Fire Code and related standards.

According to WAC 296-800-22035, cited on the L&I Web site regarding the storage of materials at the workplace, you must:

- Store materials so they do not create a hazard.
- Keep workplace storage areas free from accumulation of materials that could create hazards from tripping, fire, or explosion.

The accumulation of combustible or explosive vapors from the bulking of flammable liquids could create a hazard of fire or explosion. Activities which can generate these vapors include: bulking oil-based paint, thinners, solvents; evacuation of spray paint aerosol cans; and consolidation of propane containers. One way to mitigate such hazards in the workplace is to provide sufficient ventilation.

For the protection of worker health, WAC 296-62-07102 states when you are allowed to rely on respirators, rather than ventilation, to protect employees from breathing contaminated air.

> "In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, vapors, or aerosols the goal must be to prevent atmospheric contamination. You must use, if feasible, accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, you must use respirators as required by chapter 296-62 WAC, Part E."

Included in the list of air contaminants for which the use of general and local exhaust ventilation can mitigate worker exposure are acetone, petroleum fumes, turpentine, various alcohols, gasoline, toluene and many other common MRW flammable liquid vapors.

The Washington occupational health standards set limits on worker chemical exposure mainly based on acute (short-term) exposure levels. Long-term health effects, also called "chronic" health effects, are less well understood and there is little in rule to limit exposure levels based on these kinds of effects. Consequently, it is prudent to provide a conservative level of employee protection to the extent practical. In that vein it is better to provide more than the minimum ventilation required by law. An additional benefit may be higher worker morale and productivity.

The only numeric performance measure in the solid waste rule is in the operating standards for MRW fixed facilities which require that "[f]lammable or explosive gases do not exceed ten

percent of the lower explosive limit in the area where MRW is handled." Adequate ventilation and prudent materials handling practices typically keep the concentration of flammable or explosive gases below this threshold.

There are two basic types of ventilation - area ventilation and local exhaust (spot) ventilation. Because most dust and vapors are generated at a specific work station at MRW facilities, local exhaust ventilation is the primary method that should be used to remove dangerous vapors and dust from the workers' breathing zone and from the work area. This local (spot) ventilation is often accomplished by using a fixed-location exhaust register or a movable articulated-arm ventilator (see image at left). The closer the ventilator can be practically located to the source of the air contaminant, the more effective the removal of that hazard will be. In addition, the ventilation should draw air away from the worker's breathing zone as opposed to through the worker's breathing zone.

HHW Spot Ventilation at Cowlitz County

The design and troubleshooting of industrial ventilation systems should be handled by a qualified ventilation engineer or firms specializing in this field. However, a basic knowledge of how exhaust ventilation systems work and some basic troubleshooting tips are included in a ventilation guideline from the L&I Web site. In addition, the specific rules governing workplace ventilation are part of Washington Administrative Code Chapter 62 - General Occupational Health Standards, Part L. For the more technically inclined, one of the standard references, which is specifically recognized by L&I for ventilation, is the American Conference of Governmental Industrial Hygienists' (ACGIH's) Industrial Ventilation: A Manual of Recommended Practice, 23rd Ed.

Where flammable liquids are stored in drums there are specific safety requirements for ventilation, which can be mechanical or natural (also called gravity ventilation). The L&I rule WAC 296-24-33009 states for ventilation of flammable liquid storage rooms that:

> "Every inside storage room shall be provided with either a gravity or a mechanical exhaust ventilation system. Such system shall be designed to provide for a complete change of air within the room at least six times per hour. If a mechanical exhaust system is used, it shall be controlled by a switch located outside of the door. The ventilating equipment and any lighting fixtures shall be operated by the same switch. A pilot light shall be installed adjacent to the switch if Class I flammable liquids are dispensed within the room. Where gravity ventilation is provided, the fresh air intake, as well as the exhaust outlet from the room, shall be on the exterior of the building in which the room is located." [emphasis added]

This section of the L&I rule contains many other safety and health requirements for the storage of flammable liquids. Some areas of this rule also reinforce or restate similar requirements in the Uniform Fire Code.

The locally adopted version of the Uniform Fire Code will have provisions for ventilation where flammable liquids are being consolidated, indoors or outside, for instance when oil-based paint, thinners, or gasoline are being poured into a 55-gallon drum. This is considered by the Uniform Fire Code to be a "dispensing" or "mixing" activity. Article 79 of the 2000 Uniform Fire Code, Flammable and Combustible Liquids, contains an area-ventilation specification as well as local-ventilation requirements often applied to areas in a building where flammable and combustible liquids are being dispensed or mixed. Section 7903.2.3.4.2 of the Uniform Fire Code states that:

> "[c]ontinuous mechanical ventilation shall be provided at a rate of not less than 1 cubic foot per minute per square foot of floor area over the design area. Provisions shall be made for introduction of makeup air in such a manner to include all floor areas or pits where vapors can collect. Local or spot ventilation shall be provided when needed to prevent the accumulation of hazardous vapors."

The Uniform Fire Code refers to the Building and Mechanical Codes for other design requirements. In addition, there is an exception where natural ventilation can be shown to be effective for the materials used or dispensed. There is also an exemption for open container quantities up to 60 gallons for some less volatile flammable liquids if the building is protected by an approved automatic sprinkler system. The local fire official is the person who will interpret the locally adopted version of the Uniform Fire Code, including ventilation requirements, on a case-by-case basis.

Meeting all of the various ventilation requirements can be complex. Local fire officials and L&I must be consulted to determine the ventilation system that meets these requirements for an individual facility. To provide a summary of some of the standards mentioned above which have associated numeric values, the following table is provided.

Summary of numeric standards cited in the Q&A		
Standard origin	**Numeric performance or design standard**	**Standard or citation**
Solid Waste Rule	**Less than 10 percent LEL for flammable vapors**	**WAC 173-350-360 (6)(a)(xi)**
Labor and Industries	**List of air contaminant concentration limits**	**WAC 296-62-07515**
Labor and Industries	**More than six complete air changes per hour**	**WAC 296-24-33009**
Uniform Fire Code	**One cubic foot of air per minute per square foot of design floor area**	**Section 7903.2.3.4.2 UFC**